不同莫耳濃度之氯化亞鐵四水合物與氯化鐵六水合物製備之磁性奈米粒子在腫瘤熱治療效益之探討

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摘要

本文首先以不同鐵化合物材料及不同莫耳濃度比值，製備磁性奈米粒子磁流體並探討其腫瘤熱治療（magnetic fluid hyperthermia, MFH）之效益。氯化亞鐵四水合物（FeCl2·4H2O）與氯化鐵六水合物（FeCl3·6H2O）所製備之磁性奈米粒子，於 Fe2+：Fe3+=1：1、1：1.5 與 1：2 有最高之 SAR 值，其分別為 84.7±12.7、93.4±14.2、89.2±6.4 W/g。氯化亞鐵四水合物與硝酸亞鐵九水合物所製備之磁性奈米粒子，於 Fe2+與 Fe3+莫耳數比等於 1：1 時，有最高之 SAR 值（28.5±1.9W/g）。以硫酸亞鐵七水合物與氯化鐵六水合物所製備之磁性奈米粒子，於 Fe2+：Fe3+ = 1：2.5、2.5：1、3：1 時有最高比吸收率（SAR）值，其分別為 62.0±6.5、59.4±10.3、66.0±5.0 W/g。硫酸亞鐵七水合物與硝酸亞鐵九水合物所製備之磁性奈米粒子，於 Fe2+：Fe3+=2.5：1、3：1 有最高之 SAR 值，其分別為 66.6±7.0、63.5±6.0 W/g。由實驗結果得知，在製備之磁流體中，Fe2+與 Fe3+莫耳數比，及不同鐵化合物材料明顯影響比吸收率值。以氯化亞鐵四水合物與硝酸亞鐵九水合物製備之磁性奈米粒子，其 SAR 值最低，加熱效率經評估最差。硫酸亞鐵七水合物與氯化鐵六水合物；及硫酸亞鐵七水合物與硝酸亞鐵九水合物之結果並無太大差異。

以氯化亞鐵四水合物與氯化鐵六水合物所製備之磁性奈米粒子，鐵離子莫耳數比值為 1：1.5，可獲最高之 SAR 值，評估在腫瘤熱治療加熱效率經最佳。

關鍵字：氯化亞鐵四水合物、氯化鐵六水合物、莫耳濃度、比吸收率、磁流體熱治療

Study on the effect of magnetic fluid hyperthermia by using ferrous chloride tetrahydrate and ferric chloride hexahydrate with different molarities

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Abstract

The effect of magnetic fluid hyperthermia were evaluated by using ferrous chloride tetrahydrate and ferric chloride hexahydrate with different molarity in this work. We also compare the other iron compounds including iron(III)nitrate 9-hydrate, ferrous sulfate 7-hydrate. The SAR values of ferrofluids were found to be 84.7±12.7, 93.4±14.2 and 89.2±6.4 W/g, respectively, when prepared by using ferrous chloride tetrahydrate ($FeCl_2 \cdot 4H_2O$) and ferric chloride hexahydrate ($FeCl_3 \cdot 6H_2O$), with the 1：1, 1：1.5 and 1：2 ratio of iron compound’ s molarity . The highest SAR (specific adsorption rate) value of ferrofluid was found to be 28.5±1.9W/g , when prepared by using ferrous chloride tetrahydrate ($FeCl_2 \cdot 4H_2O$) and iron(III)nitrate 9-hydrate($Fe(NO_3)_3 \cdot 9H_2O$) with the 1:1 ratio of iron compound’ s molarity. The SAR values of ferrofluids were found to be 62.0±6.5, 59.4±10.3, and 66.0±5.0 W/g, respectively, when prepared by using ferrous sulfate 7-hydrate ($FeSO_4 \cdot 7H_2O$) and ferric chloride hexahydrate ($FeCl_3 \cdot 6H_2O$) with the 1：2.5, 2.5：1, and 3：1 ratio of iron compound’ s molarity . The SAR values of ferrofluids were found to be 66.6±7.0 and 63.5±6.0 W/g respectively, when prepared by using ferrous sulfate 7-hydrate ($FeSO_4 \cdot 7H_2O$) and iron(III)nitrate 9-hydrate ($Fe(NO_3)_3 \cdot 9H_2O$), with the 1：1, 1：1.5 and 1：2 ratio of iron compound’ s molarity .

The highest SAR value of ferrofluid is 93.4±14.2 W/g when prepared by using ferrous chloride tetrahydrate and ferric chloride hexahydrate with the 1：1.5 ratio of iron compound’ s molarity . The heating quality of ferrofluid for magnetic fluid hyperthermia is better when comparing with other iron compounds .

Keywords：ferrous chloride tetrahydrate、ferric chloride hexahydrate、molarity 、specific adsorption rate、magnetic fluid hyperthermia (MFH)